DAM BREAK DURING THE FLOOD IN SAXONY/GERMANY IN AUGUST 2002

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ABSTRACT

The heavy rainfall event in August 2002 in Saxony/Germany caused the break of a flood retaining basin in a valley of the Erzgebirge Mountains. The rainfall event with its hydrologic characteristics and dam break event were analysed and an outflow hydrograph was determined. The propagation of the dam break flood wave in the valleys of the Briesnitz and Müglitz Rivers has been simulated. Calculated values were compared with some observed data.

Keywords: dam break, flood, flood retaining basin

1 INTRODUCTION

In August 2002 a heavy rainfall event lasting two days occurred in Saxony. The region in the East Ore Mountains (Osterzgebirge) was strongly affected. There are some streams and rivers with small catchment areas. Hence the flood waves develop rapidly after strong storm events. To protect people from floods there are some existing flood retention basins and there is also a new one under construction in valley of the river Müglitz.

2 THE GLASHÜTTE DAM

The town of Glashütte, famous for its watch manufactures is situated in the South of Saxony in the eastern part of the Erzgebirge Mountains. The flood retention basin is situated about 2 km upstream Glashütte in the valley of the river Briesnitz. The catchment area of Briesnitz and Johnsbach Rivers is about 10 km². The Briesnitz River is a left tributary of the Müglitz River, which discharges into the Elbe River near Dresden.

The flood retention basin was built from 1951 to 1953. The reservoir storage was about 50 000 m³ (http://www.glashuette-sachs.de/flut.htm). In times without rain the basin was empty and the Briesnitz River flew through the dam in an outlet gallery.

The barrage is an earthfill embankment dam with a straight dam axis and a height of about 9 m. The dam crest level is about 388.7 a.s.l. The upstream and downstream face is sloped 1 on 2 and covered with grass. After the breach it is now obviously that there are stones within the earth material of the dam, especially in the upper part of the dam. There is no sealing in the upstream dam face and no drainage in the downstream dam toe.

Figure 1: Broken section (left) and stepped spillway (right) after rupture.

There is a stepped spillway with 7 steps each 1m high. It had a capacity of about 5 m³/s just when the water level reached dam crest (Figure 1). The river Briesnitz passed the dam through outlet tunnel with natural stoned masonry. Cross section of the outlet is about 1.7 m². The discharge through the outlet is reduced to 7 m³/s in order to protect the downstream town.

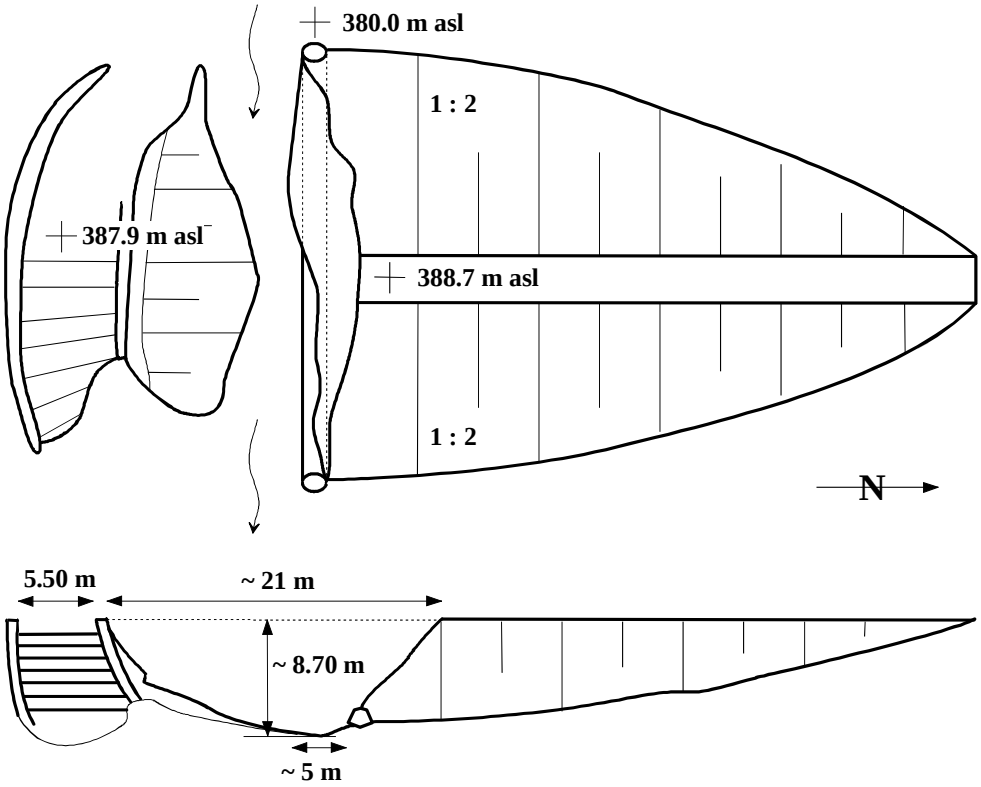

Figure 2: Glashütte embankment dam in plan (top) and downstream elevation (bottom).

Figure 1 shows two photos of the final dam breach and in Figure 2 a sketch of the final breach of Glashütte embankment dam measured on 23. August 2002 is given.

3 METEOROLOGIC-HYDOLOGIC SITUATION

A very heavy storm event occurred in Saxony/Germany caused by low pressure area coming from Gulf of Genoa in the north of Italy. In the Ore Mountains (Erzgebirge) the warm moist air from the south met cold air from the north.

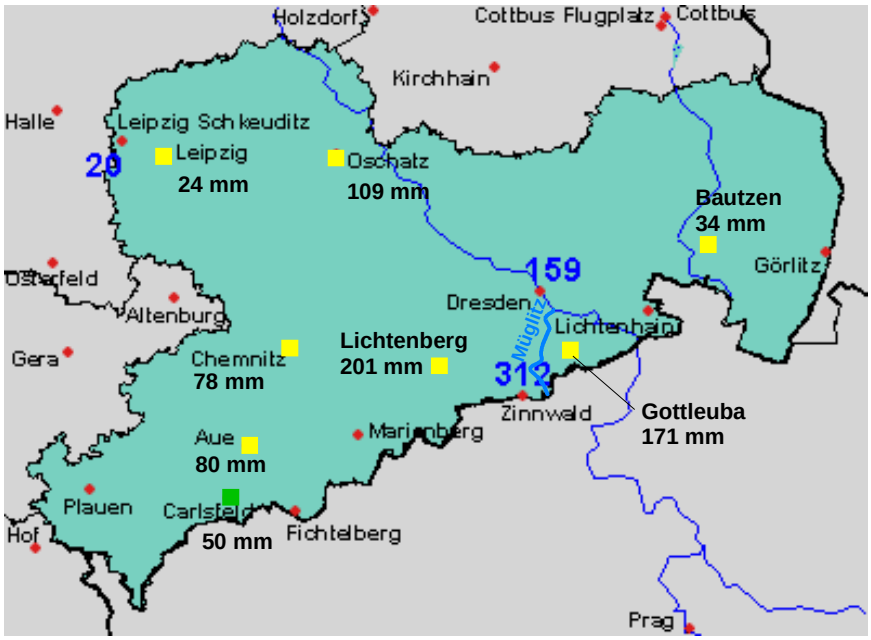

Figure 3: Rainfall map of Saxony with values of 24-hour-rainfall in mm = l/m² between 12. August 2002 7.00 a m and 13. August 2002 7.00 a m.

First analysis of rainfall for catchment areas into region yielded a peak discharge per unit area 2.3 m³/s*km² (LfUG 2002). The whole water volume per unit area was about 200 000 m³/km².

4 THE DAM BREAK

There are some eye witnesses watched the dam break and could give some facts about the dam break process. The filling of the empty basin began on 12. August 2002 at 9.00 a m. The water level of the basin reached 383.5 m asl at 9.30 a m, 384.5 m asl at 10.30 a m and 385.5 m asl at 11.00 a m. At 0.30 p m the water began to flow over the spillway. Only a quarter later the overtopping of the dam started. The overtopping head was reported with some decimetres above the dam crest near the spillway and some centimetres at the northern side of the dam crest. The erosion of the dam crest began with a shallow breach being 3 – 5 m wide.

It was observed that the dam failed within half an hour between 4.10 p m and 4.40 p m. The dam material was eroded in the form of big clods which were instantaneously transported downstream by the water.

After the dam break the water level in the dam fell down and the seepage water flew out at the upstream dam basis.

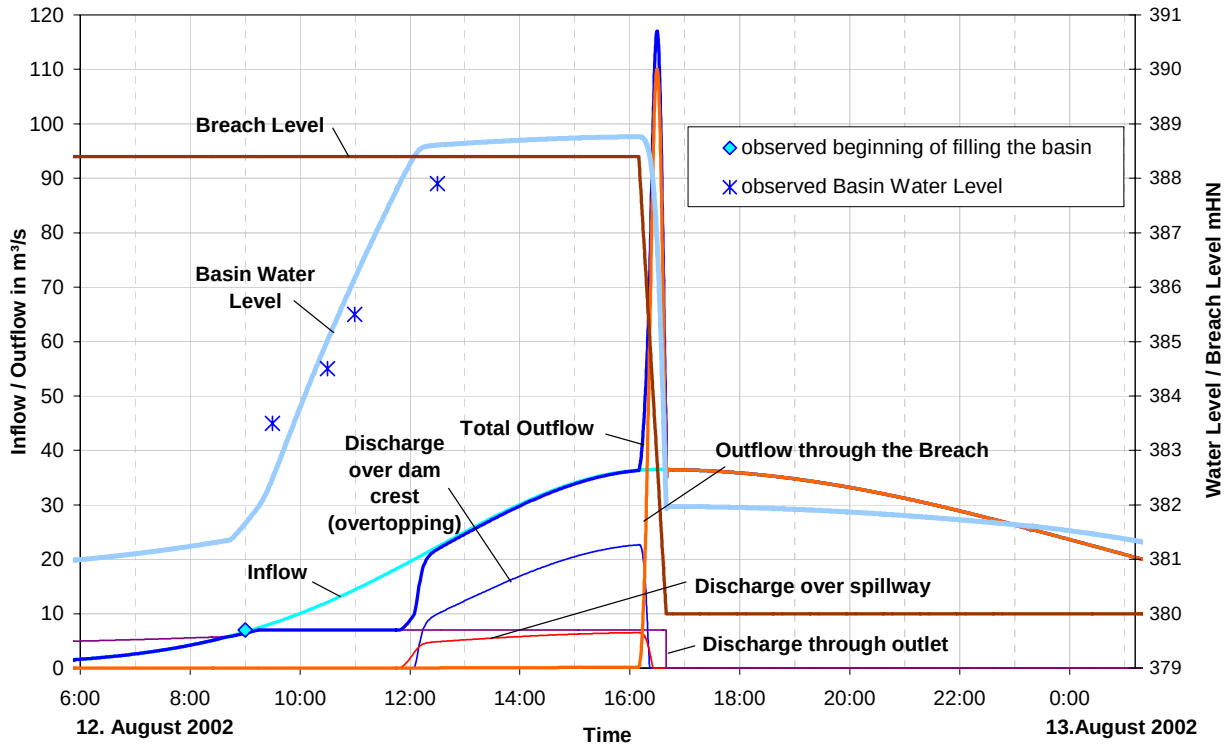

Figure 4: Calculated outflow during the flood and dam break event.

Because only a few data are available about dam break it was necessary to provide a basis for calculation of outflow during dam break.

A first estimate of the peak discharge on the basis of the knowledge from adjacent catchment areas was made with the formula:

$$HQ_1 = HQ_2 \cdot \left(\frac{AE_1}{AE_2} \right)^{0,75} .$$

In this way a peak inflow of HQ_1 = 36 m³/s was yielded. The inflow hydrograph was formed with an exponential function with different coefficients for increasing and decreasing discharge. The whole amount of water, flowing through the dam site was calculated to 1.9 hm³. This is similar to values of adjacent catchment areas with a discharge volume per unit area of 0.2 hm³/km².

Fitting the water level graph to the observation points reported by the eye witnesses the curve in Figure 4 was yielded. From this could de derived that the dam break occurred when the inflow hydrograph reached its maximum.

An outflow peak of 117 m³/s was calculated with an assumed linear breach extension and a breach development time of 0,5 h (as observed).

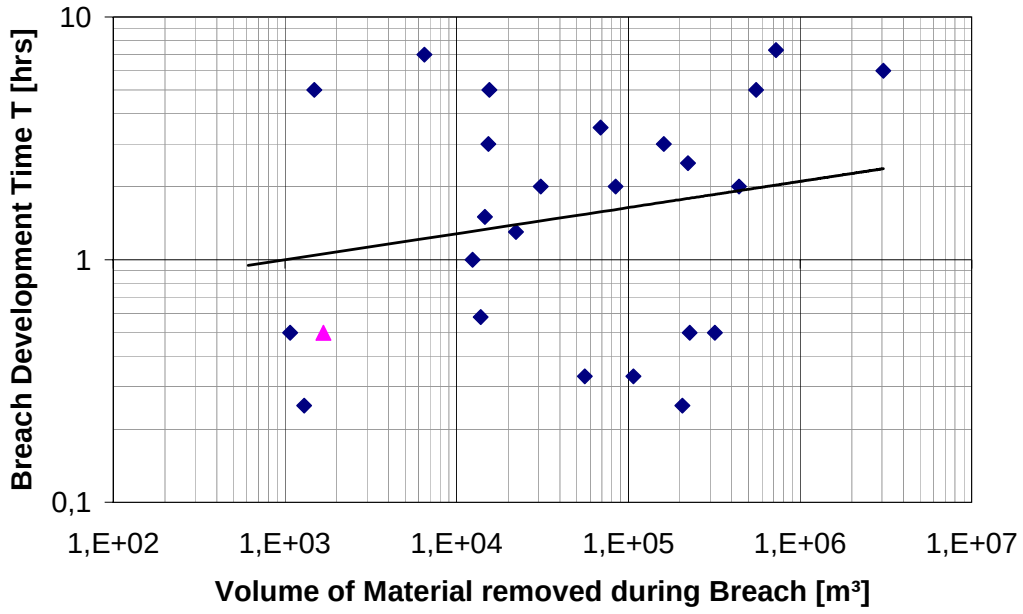

Figure 5: Removed embankment material versus breach development time - Glashütte Dam in comparison with dam break data after *MacDonald/Langridge-Monopolis1984*.

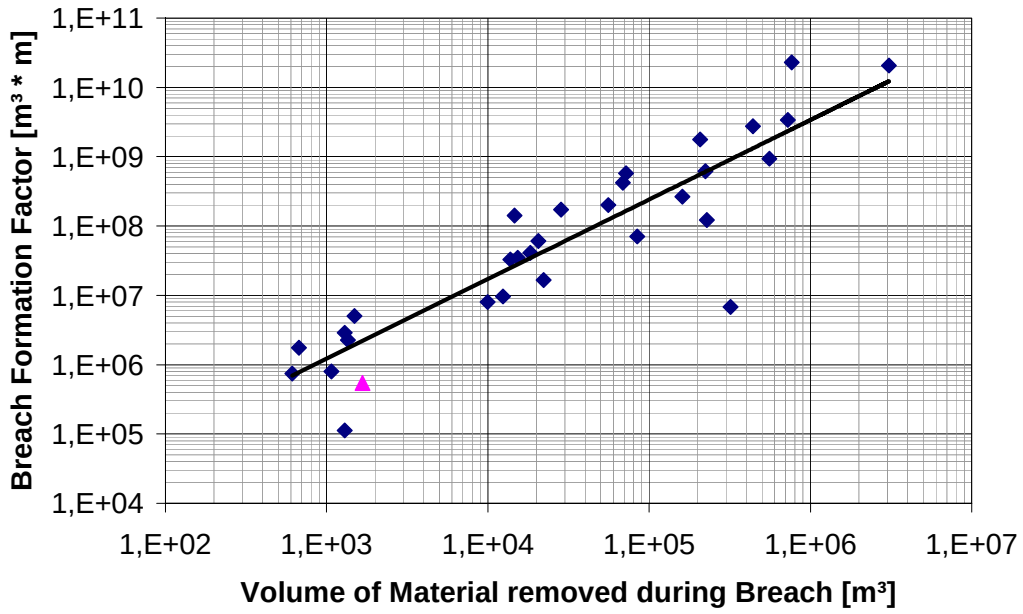

Figure 6: Removed embankment material versus BFF - Glashütte Dam in comparison with dam break data after *MacDonald/Langridge-Monopolis 1984*.

The volume of material removed during the breach was calculated to be about 1700 m³. A comparison with values of breach characteristics of other earth dams given by *MacDonald/Langridge-Monopolis 1984* shows that the breach characteristics of the Glashütte Dam lie in the same value range.

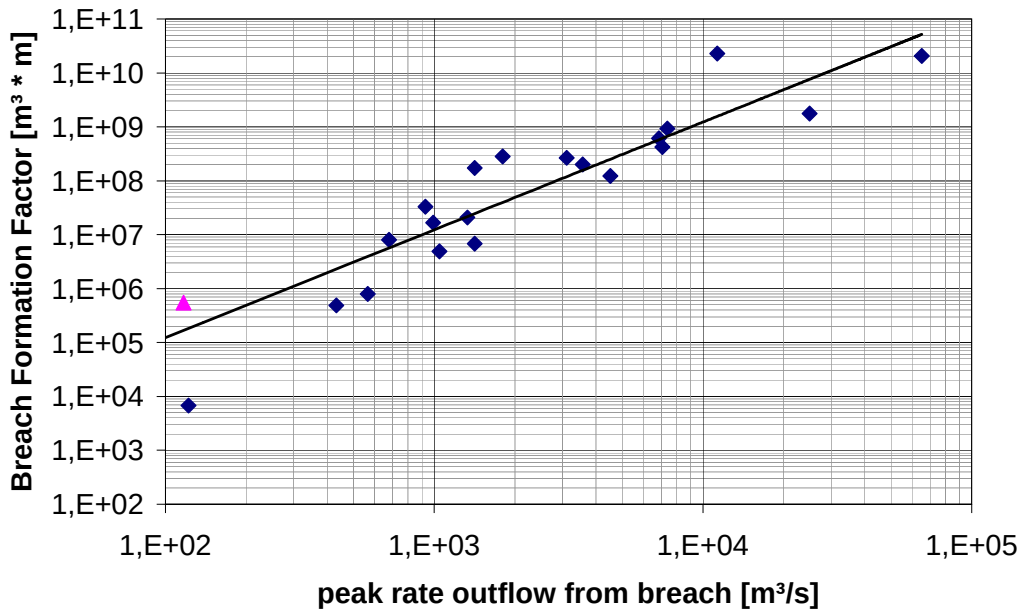

Figure 7: Peak rate outflow versus BFF - Glashütte Dam in comparison with the data by *MacDonald/Langridge-Monopolis 1984*.

The peak discharge is smaller than expected from the viewpoint of BFF. That is due to the relatively long breach development time of 0,5 h.

5 THE FLOOD WAVE IN BRIESNITZ AND MÜGLITZ VALLEY

The dam break happened in connection with a flood event which had not been recorded yet if you focus on duration and intensity of precipitation. In the lower part of the Müglitz Valley the flood reached its peak during the night from 12. to 13. August 2002.

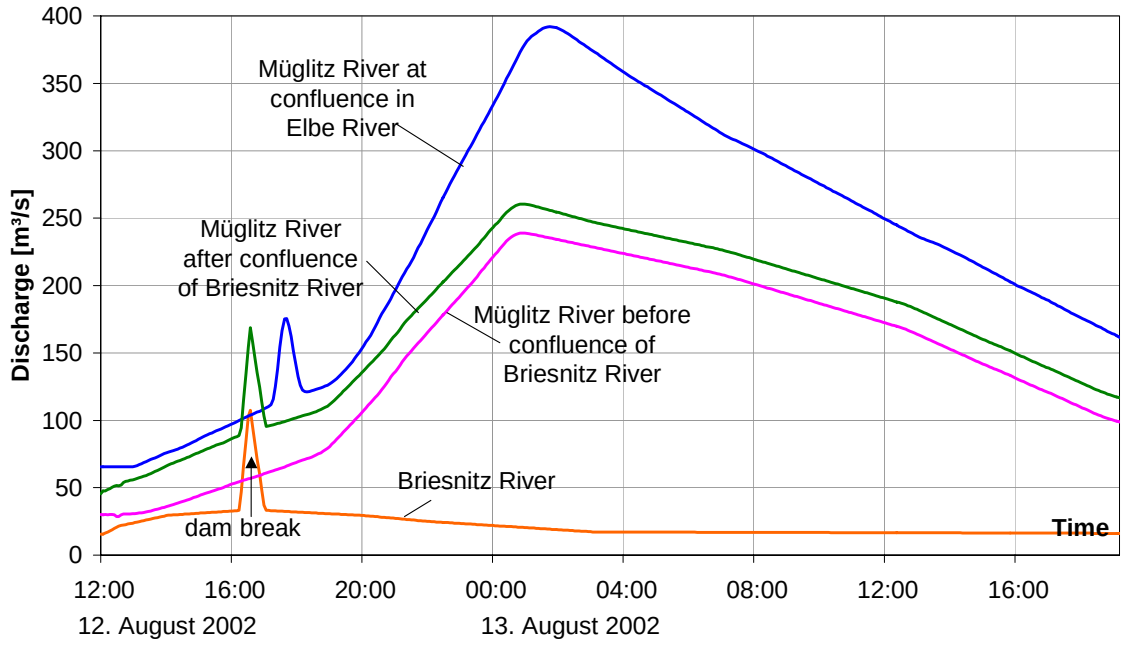

Figure 8: Calculated discharge hydrograph in the Briesnitz and the Müglitz River during the rain flood and dam break event.

As the break happened on 12. August between 4.10 and 4.40 p m its peak did not coincide with the peak caused by the rain in the Müglitz River. The graphs in Figure 8 show that the peak due to the dam break did not exceed the later passing peak of the Müglitz River. Therefore the additional damages due to the break remained limited to the direct downstream reach (Figure 9).

Figure 9: Damages caused by the dam break wave in town of Glashütte.

Figure 10 shows that the water level in the town of Glashütte increased of 0.5 m due to the dam break wave during a short time.

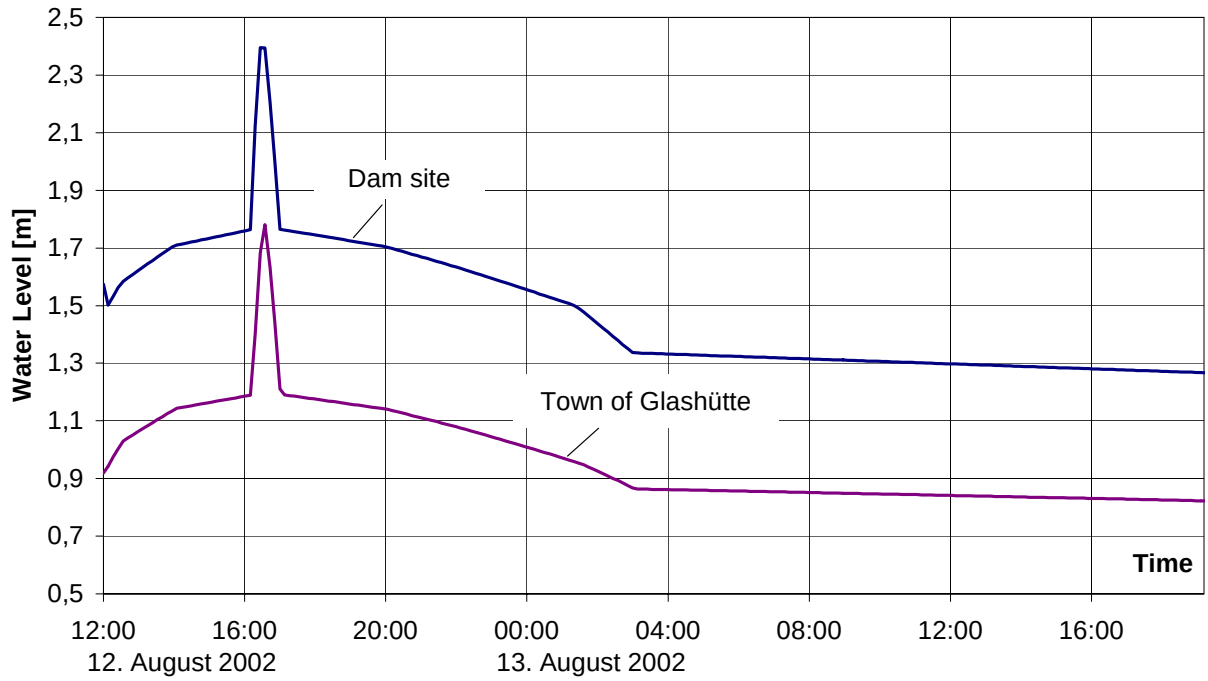

Figure 10: Calculated water level direct downstream the dam site and in the town of Glashütte.

6 CONCLUSIONS

The main reason for the Glashütte dam break was the insufficient dimensioning of the spillway and the freeboard. The situation was made worse by congesting the bottom outlet by brush-wood, trees and rubbish.

The Maximum outflow was about 120 m³/s. It could been shown that the total discharge peak in the Müglitz River was not increased by the dam break peak but the raise was accelerated.

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